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Types of contaminants

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Published online 21 October 2005 | Nature | doi:10.1038/news051017-16

News

Pollution makes for more girls

The stress of dirty air skews sex ratios in Sao Paulo.

Erika Check

Toxic fumes favour the fairer sex, a group of researchers in Brazil has found.

Babies born in highly polluted areas are more likely to be girls. © *Alamy*

Jorge Hallak and his team at the University of Sao Paulo turned up the surprising result by studying babies born in their city. They divided the metropolis of 17 million people into areas of low, medium and high air pollution, using test results from air-quality monitoring stations. They then studied birth registries of children born from 2001 to 2003.

The team found that 48.3% of babies were female in the least polluted areas, but 49.3% were female in the dirtiest parts of town. After

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Types of Pollution & Contaminants

Climate change, energy & environmental health

STUDENT ACTIVITY: A-B MONOLOGUE

Lecturer: Abel Machado

Types of Pollution & Contaminants

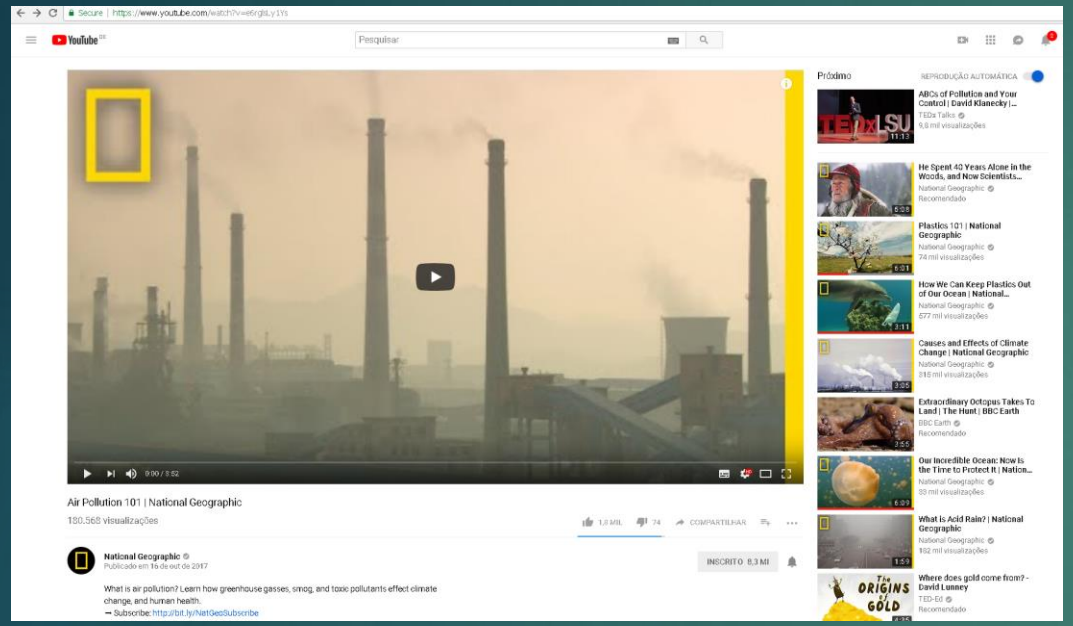
THE PROCESSES AND THE DRIVERS

Skills you gain:

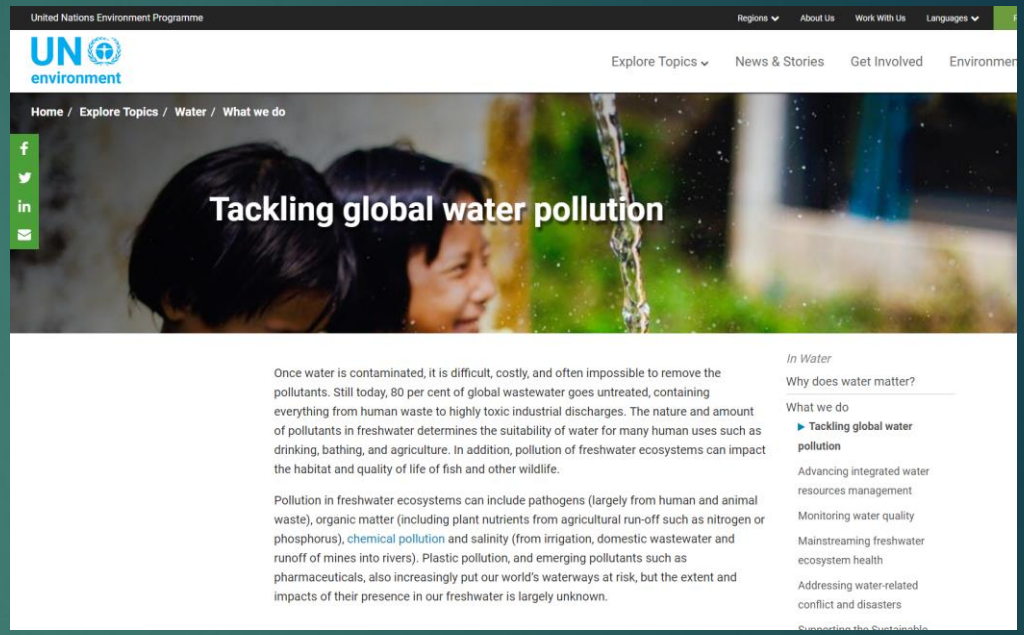
1- Understand the main kinds of pollution
2- Learn about the types of pollutants that cause them
3- Get familiar with the most significant contaminants
4- Critically evaluate the limitations for managing such diverse groups of pollutants

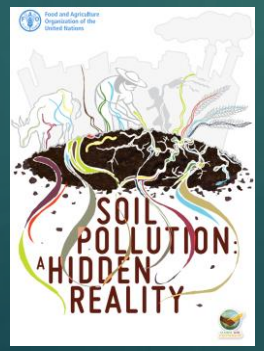
Lecturer: Abel Machado

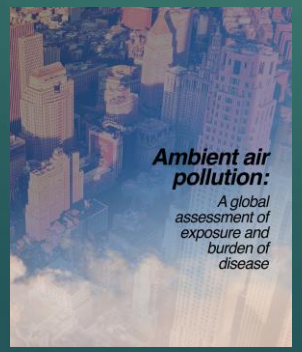
References:



https://www.youtube.com/watch?v=e6rglsLy1Ys







Does this novel contaminant compare to other potential pollutants?

Cyanobacteria at 24h exposure forming clumps, a stress and senescence response

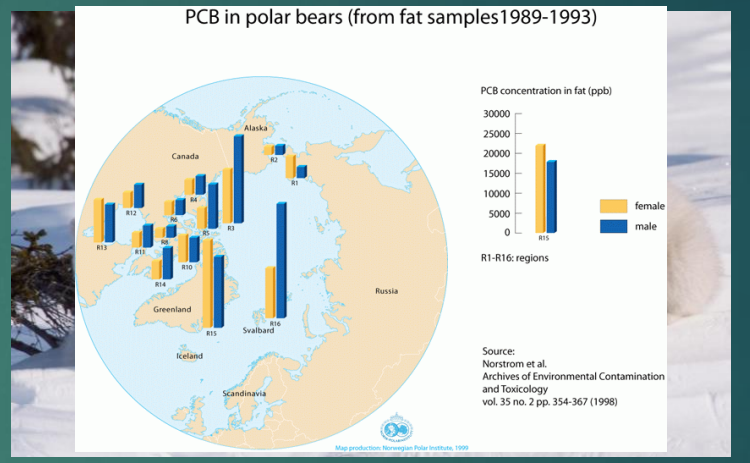
Remembering: Pollution vs Contamination

Pollution

www.straitstimes.com

- Introduction of pollutants into natural environment
- Implies adverse impacts
- Substance, matter, energy
- Mostly addition but can also be removal

Contamination



steemkr.com

- Introduction of contaminants into natural environment
- Implies presence
- Natural, xenobiotic, organic, inorganic, etc.
- Substance, matter, energy
- Mostly addition

Student activity : Let's make a list of pollutants & contaminants we know!

Facts & figures about important environmental pollutants & contaminants

Chemicals

3.4 % year $^{-1}$

319 T in 2015

117 T in 2015

Solid waste

1.3 billion T in 2012

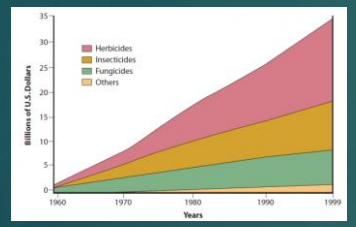
Projected for 2.2 billion T in 2025

europarl.europa.eu

Human milk

The levels of persistent organic pollutants (POPs) are significant in India, some European & African countries

Pesticides



ourworldindata.org

LMIC have increased their use of pesticides, e.g. Sudan 10-fold in last decade.

Manure

124 MT in 2016

28 MT applied to soils

86 MT left on pasture

Roads runoff

Roads and soils near roads have high levels of many kinds of contaminants

Military activities

~110 million mines or other unexploded pieces of ordnance are scattered across 64 countries on all continents

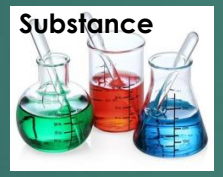
Radioactivity

Almost all soil in the northern hemisphere contains radionuclides in above the background level

There are multiple classifications for environmental pollution and pollutants

Impacted media or habitat

Properties of the pollutant



Usage

Pesticides

Fertilizers

Properties of the source

Point vs Non-point
Pulse vs Continuous

Awareness

Traditional: e.g. oil

Emerging

Others:

- Nature of impact
- Environmental risk
- Biokinetics
- Major elements
- Trace elements
- Etc.

Student activity: Let's classify our nanoplastics!

Soil pollution: An overlooked matter

Senegal, a pastoralist herds his cattle past a mound of garbage, Source: FAO

Student activity : Let's check our list. Which of the pollutants we know are soil contaminants? How to prevent this kind of pollution?

Soil Pollution is the contamination of the soils with any kind of anthropogenic stressor that results in loss of biological or environmental function

Soil pollution: Sources & Impacts

Sources

Agriculture & livestock

Natural

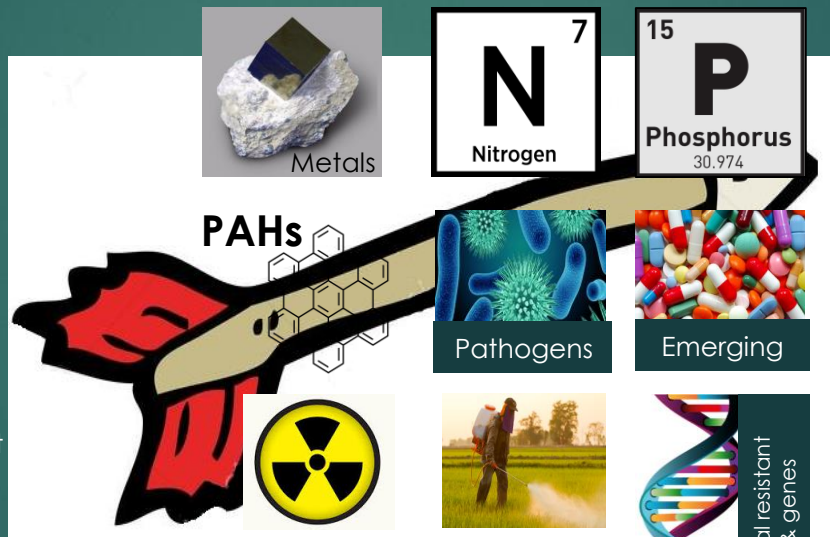
Mining

Urban & transport

Military acts

Indust

Contaminants



Impacts

Acidification

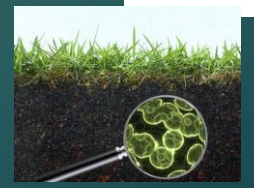
Human exposure

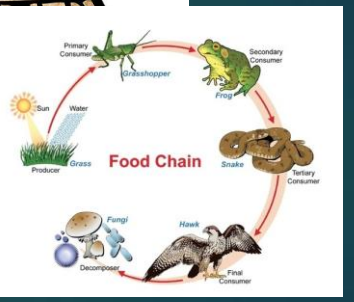
Yield loss

Erosion

Salinity

Antimic resistan reservo



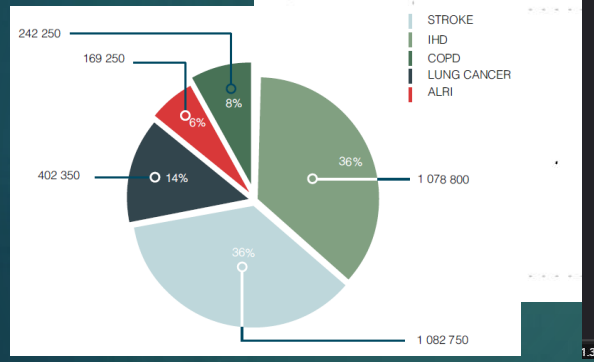


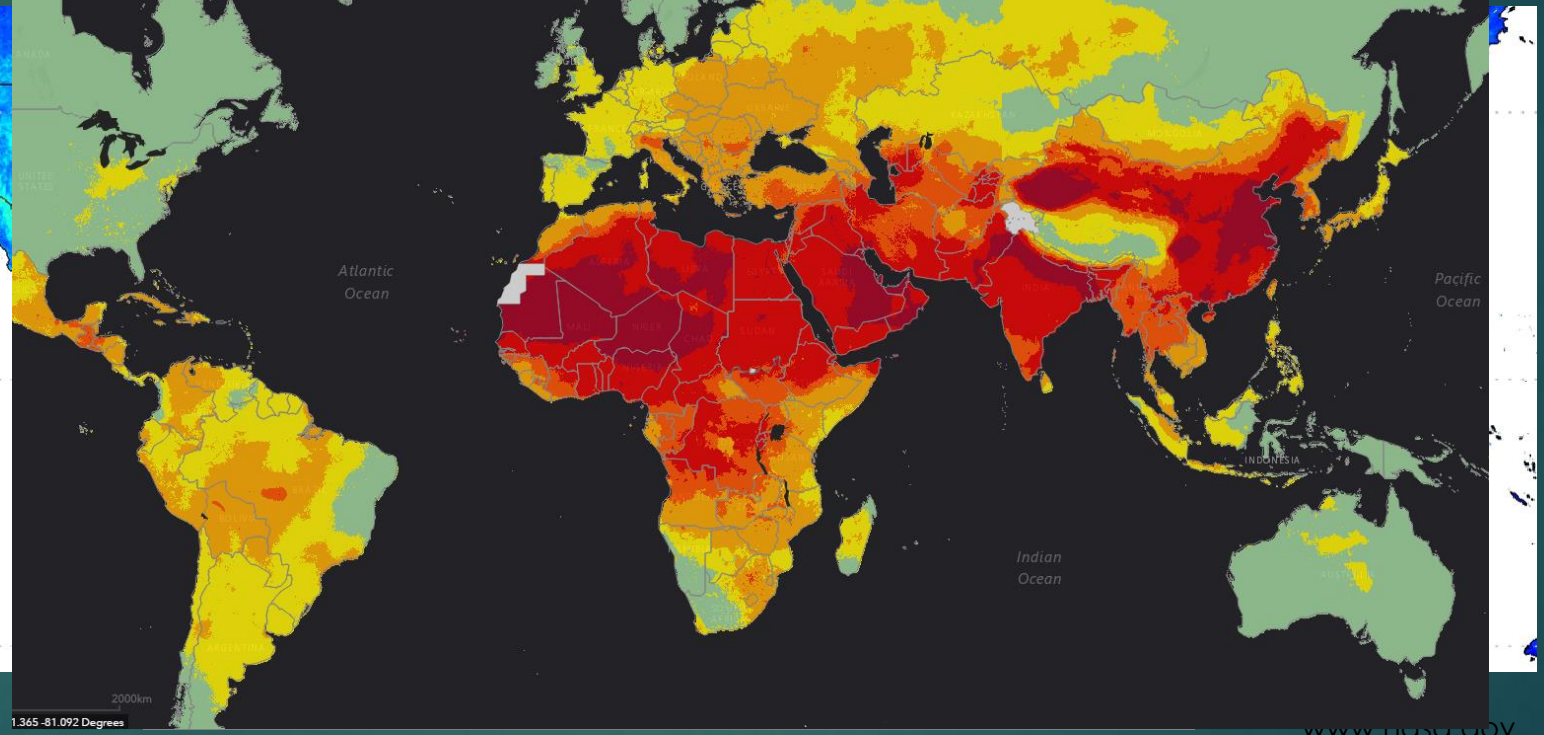
Soil Pollution is the contamination of the soils with any kind of anthropogenic stressor that results in loss of biological or environmental function

Air pollution: An environmental and human health issue

Human mortality rates (specially infant mortality) display correlation across the globe with air pollution with fine particulate matter.

4.2 million death
(3.8 due to blac





www.nasa.gov

0 5 10 15 20 50 80

Satellite-Derived $PM_{2.5}$ ($\mu g\ m^{-3}$) for 2001-2006

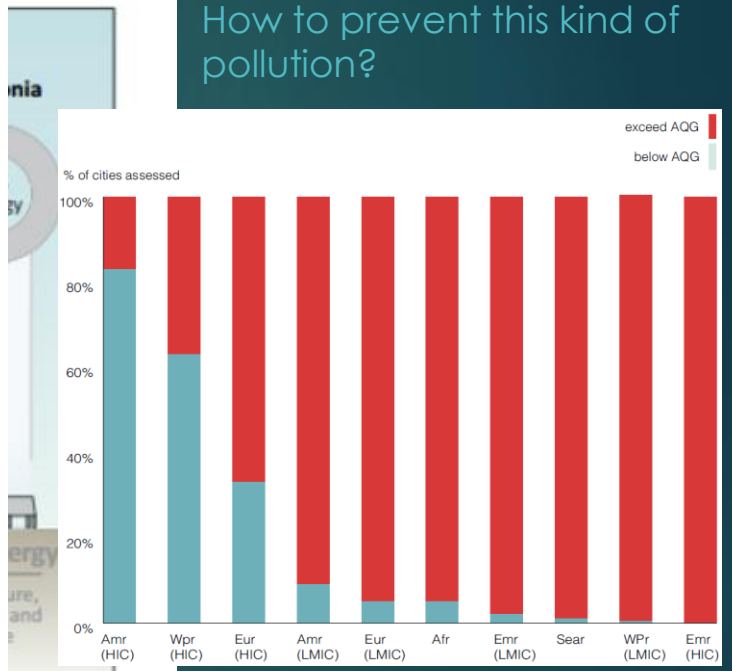
According to the WHO 92% of humans are breathing unsafe air (2017)

Air pollution is the contamination of the atmosphere with any kind of anthropogenic stressor that results in loss of biological or environmental function

Air pollution: An environmental and human health issue

Student activity : Let's check our list. Which of pollutants we know are air contaminants? How to prevent this kind of pollution?

Countries are increasingly improving air quality around the globe



WHO Report, data from 2011 or later

Air pollution is the contamination of the atmosphere with any kind of anthropogenic stressor that results in loss of biological or environmental function

Indoor chemical cokctail

Reactive chemicals in an indoor environment arise from cooking, cleaning, humans, sunlight, and outdoor pollution

VOCs and the indoor aerosol formation mechanism

The highly carcinogenic tobacco specific Nitrosamines (HONO), polycyclic aromatic hydrocarbons (PAHs) are often toxic oxidation products

Personal care products and natural human metabolite emissions might change oxidation state of skin oils

Science magazine• vol 359 issue 6376

Associated with 3 of the top 10 risk factors for negative health outcomes globally:

1- Household air pollution from solid fuels
2- Tobacco smoking
3- Ambient particulate matter pollution

Potentially high levels of (foto)oxidation induced OH

Chlorine bleach promotes oxidizing conditions not just on the surfaces being washed but throughout the indoor space

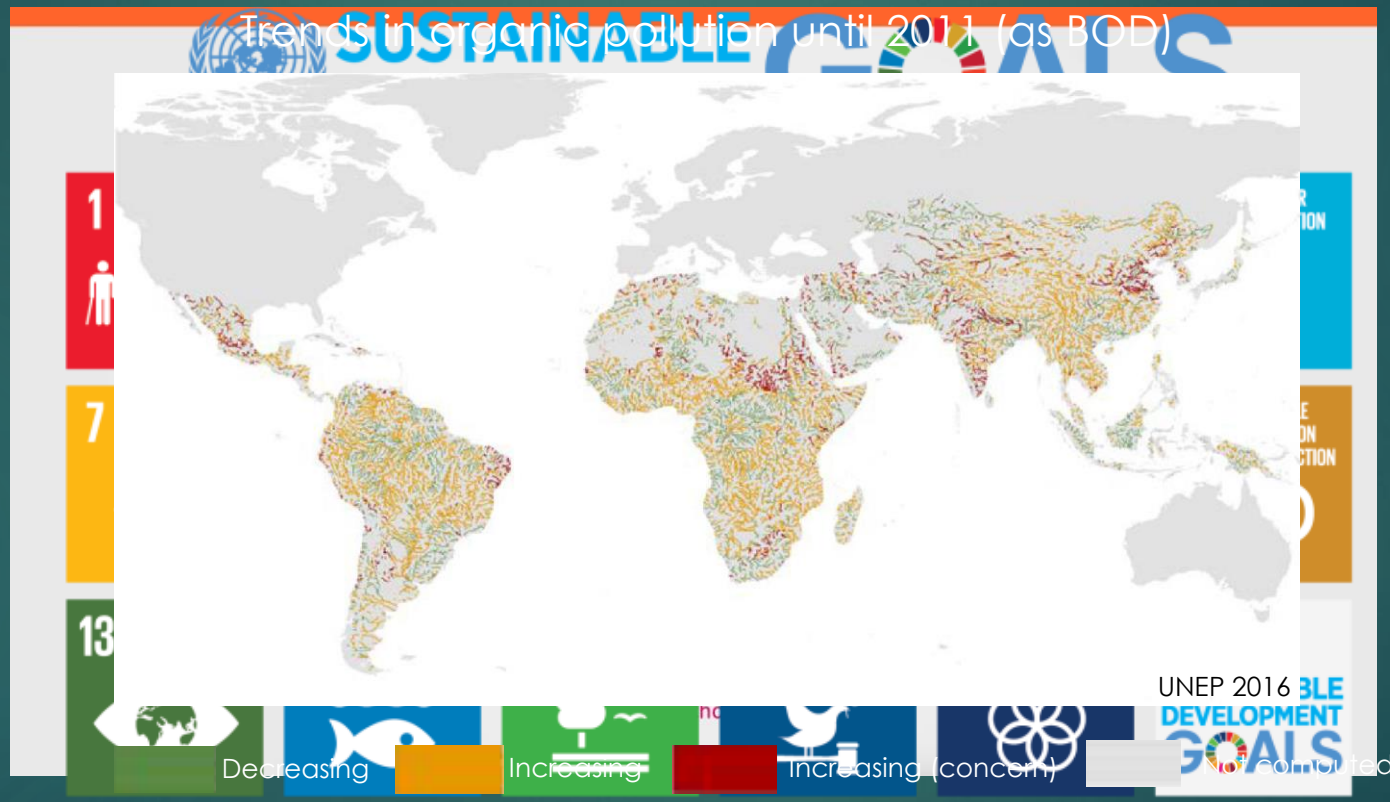
The chemistry of the indoor environment in which we live up to 90 % of our time is not nearly as well studied as outdoor habitats.

Water pollution: A final consequence of multiple stressors

Water pollution is main issue in 2 of the Sustainable Development goals, and important driver in many

Over 80 % of the world's wastewater is released to the environment without treatment

In Latin America, Africa and Asia, severe pathogenic pollution was found in one third of all rivers



Student activity : Let's check our list. Which of the pollutants we know are water contaminants? How to prevent this kind of pollution?

Water Pollution is the contamination of a water body with any kind of anthropogenic stressor that results in loss of biological or environmental function

Water pollution: Sources & Impacts

Sources

Agriculture & livestock

Natural

Mining

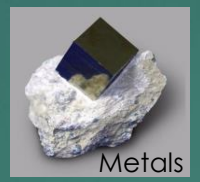
Sewage

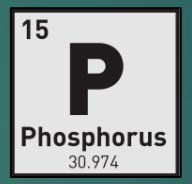
Industries

Waste

Urban & transport

Contaminants





PAHs

Pathogens

Emerging

Radionuclides

Pesticides

Persistent Organic Pollutants

Impacts

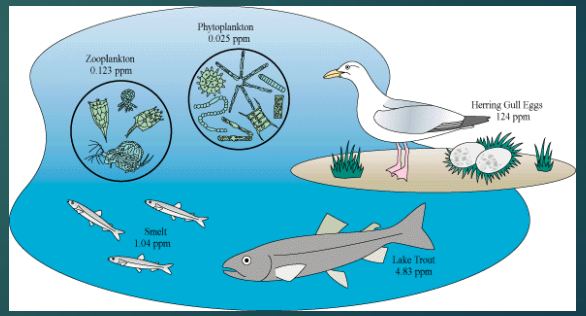
Acidification

Salinity

Human exposure

Eutrophication

Antibiotic resistance



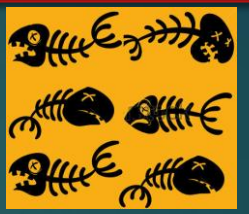
Water Pollution is thecontamination of a water body with any kind of anthropogenic stressor that results in loss of biological or environmental function

Water pollution: A heavy metal example

UK 1976-1977

Total dumped in coastal areas
(Cd, Cr, Cu, Hg, Pb, Zn)

9,000 tons/year
(Föster & Wittmann, 1979)



Toxicity (by US-EPA)
Cd 2- 40 µg/L
Cu 13- 4.8 µg/L
Pb 65- 210 µg/L

London 2013

Dumping capacity in 2 of 30 authorized landfill in Thames estuary
(toxic material)

7,200 tons/year
(Enviroment Agency, 2015)

Toxicity

→ ?

Fate & effects

Water pollution: Basics

Sources

Land-based farming, food and agro-industry, fisheries and aquaculture, oil and energy sector, waste, wastewater, packaging sector, extractives, pharmaceuticals, sound, temperature, light

Contaminant

Nitrates, phosphates, heavy metals, pesticides, endocrine disrupting chemicals, pharmaceuticals, booster biocides, waste and plastics, etc

Chemical transformation

Daughter compounds, chemical cocktail effects, leachates from landfills and air emissions in waters with primary pollutants

Transport & fate

Topography and run-off, climate and weather, biotic, and physicochemical composition of water, coastal circulation, geology and coastal erosion, aquatic biota

Impacts

Impairment of neurological functions due to harmful algal bloom and development (e.g. blue baby syndrome), heart and kidney diseases, cancer, sterility and other reproductive disorders, increased antimicrobial resistance

Eutrophication, harmful algal bloom such as blue-green algae changing habitats, toxicity, reduction in population size of species such as frogs, feminization of fish

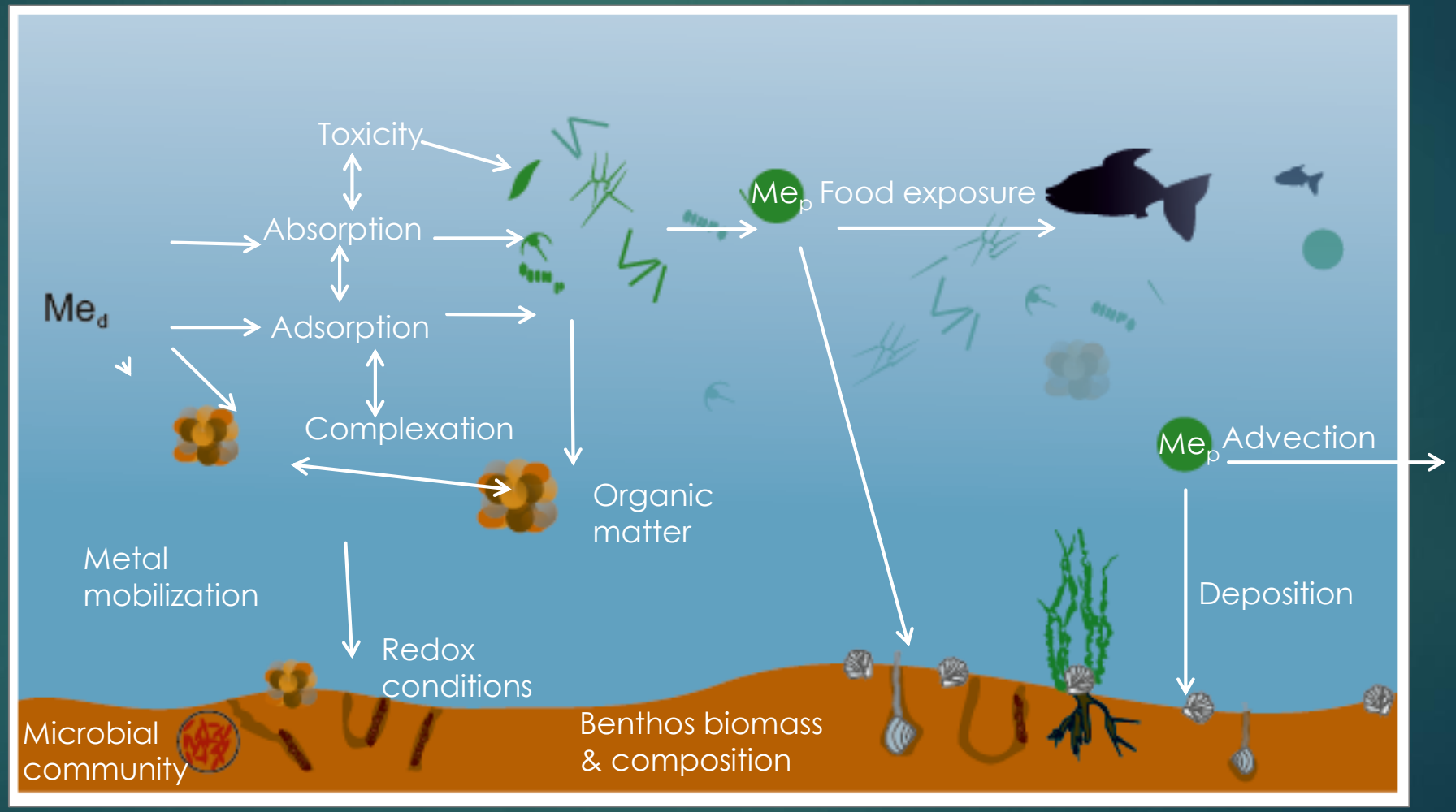
Provisioning services (e.g. productivity of food, coral reefs, flucial stocks and species and fish stocks), habitat or supporting services (e.g. changes to species distributions and functions, widespread population impacts affecting habitats and maintenance of genetic diversity

Fate Processes cause Contextual Pollution

As the outcome of water contamination is probabilistic, we often refer to contaminants as potential pollutants

Student activity: What is easier to determine: environmental pollution or contamination?

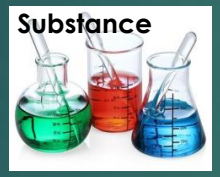
Student activity (A-B Monologue): What have I learned today



Machado et al. STOTEN (2016) 541:268-281

Types of contaminants (potential pollutants)

Properties of the pollutant



Properties of the source

Point vs Non-point
Pulse vs Continuous

Others:
- Nature of impact
- Environmental risk
- Biokinetics
- Major elements
- Trace elements
- Etc.

Usage

Pesticides

Fertilizers

Awareness

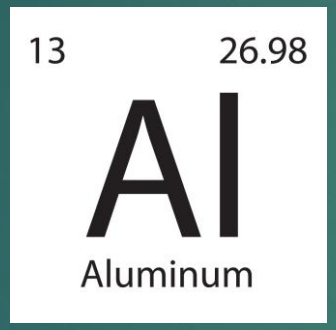
Traditional: e.g. oil

Emerging

Types of contaminants: Environmental level

Major elements & contaminants

Organic matter

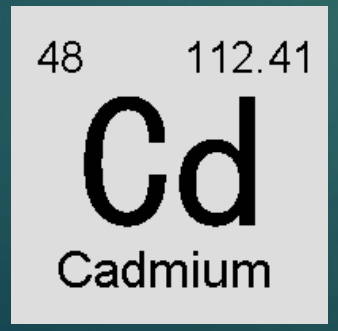


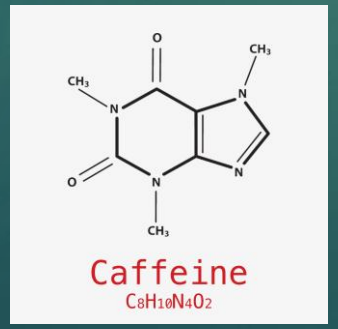
Nickel

Iron

Phosphate

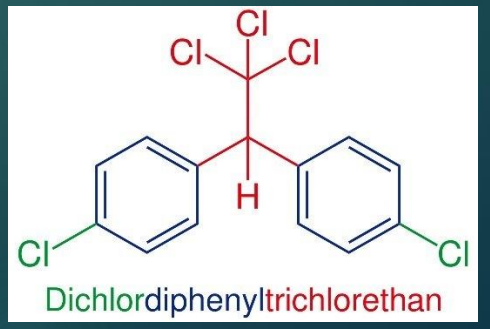
Trace elements & Micro-contaminants





Pharmaceuticals

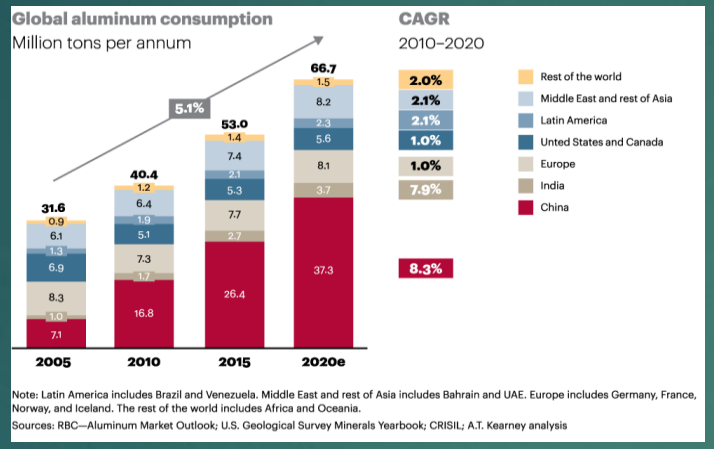
Copper

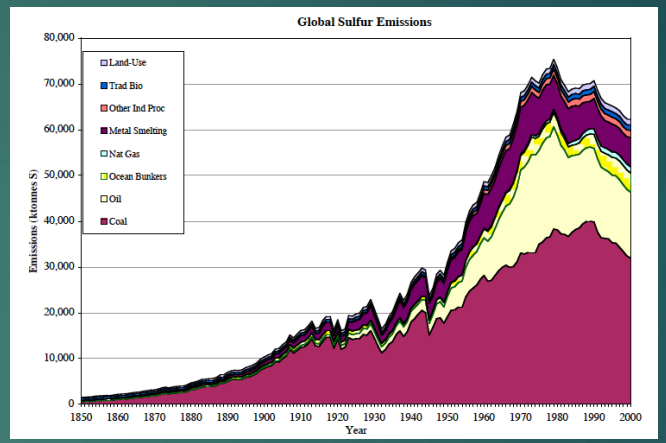


Major elements with significant influence

Elements that compose the majority (95 %) of Earth surface

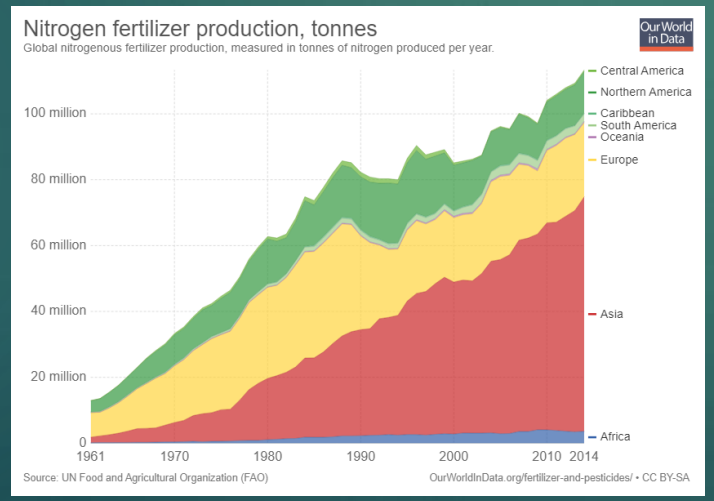
These elements generally present:
1- Low toxicity
2- Low bioaccumulation
3- Low biomagnification

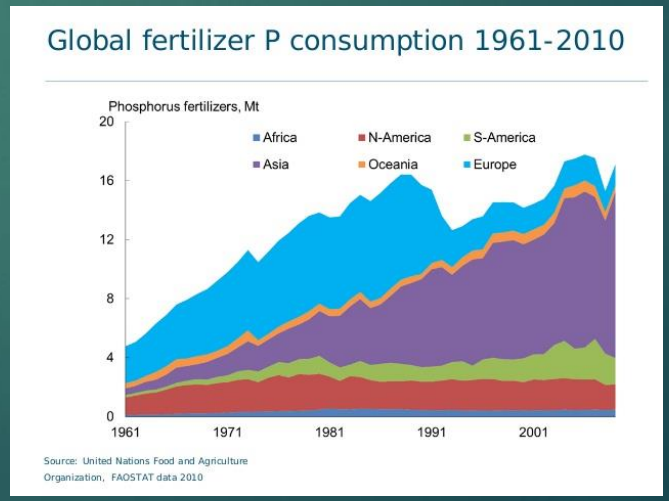




These elements generally present:
High potential to change biogeochemistry of the Earth system

Human induced changes in the natural form may induce toxicity

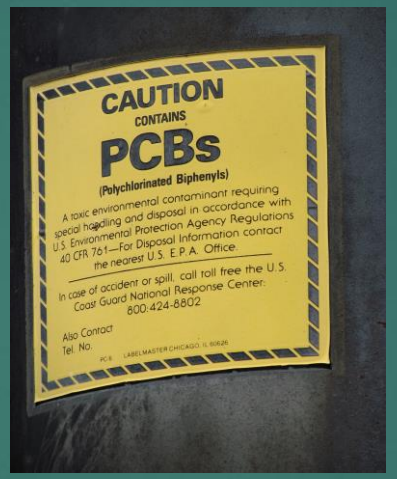




Commonly studied major elements are: Al, Ca, Fe, K, Mg, Na, Si, Ti, POC, N, P, S

Micro-contaminants with historical significant influence

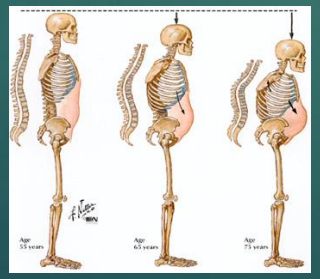
DDT – around the world



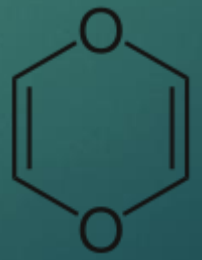
PCBs in Japan and Taiwan

Mercury in Japan

These elements generally present:
1- High toxicity
2- High bioaccumulation
3- High biomagnification



Cadmium in Japan

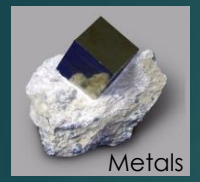


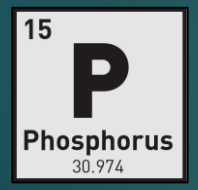
Dioxins (like)– various

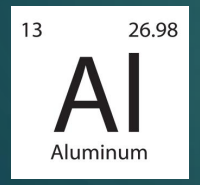
Going further into classification groups

Chemical

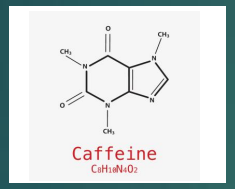
Inorganic

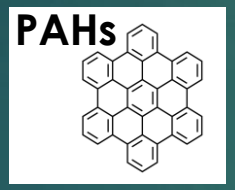


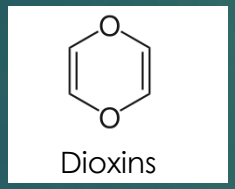




Organic

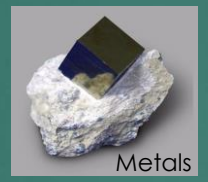






Awareness

Traditional



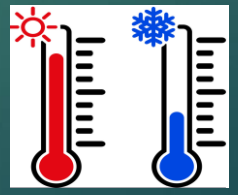
Emerging

Hazard & Risk

Energy

Light

Sound


Temperature

Radionuclides

Student activity: Let's classify our nanoplastics!

Managing environmental contamination & pollution

Classification of contaminants and pollutants is important

- Most of countries have legal tools to regulate pollution
- Point sources and certain uses are easier to regulate
- There is an increasing trend to REDUCE the use of environmental contaminants
- There is an increasing trend to RE-USE materials that are potential pollutants
- There is an increasing trend to RECYCLE materials in general

STUDENT ACTIVITY: A-B MONOLOGUE

USING THE CONCEPTS WE LEARNED TODAY, EXPLAIN TO YOUR COLLEAGUE WHICH CLASSES OF POTENTIAL POLLUTANT WOULD YOU PLACE NANOPLASTICS

Thanks

NOW WE WILL START TO OPTIMIZE OUR TOXICITY TESTS WITH NANOPLASTICS